User Manual for Tracker Testbed

Version 2.2
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May 23, 2005

1. Required DLL Library

Three DLLs listed below are required to run the executable file. They can be put in the same directory as CTracker.exe or else registered in the windows system path.

- cv096.dll
- highgui096.dll
- cxcore096.dll

2. Main GUI window

As shown in Figure 1. The main window displays the original image frame and a bounding box of the tracking result. At the top of the main window is the tracker parameter status bar and command button bar.

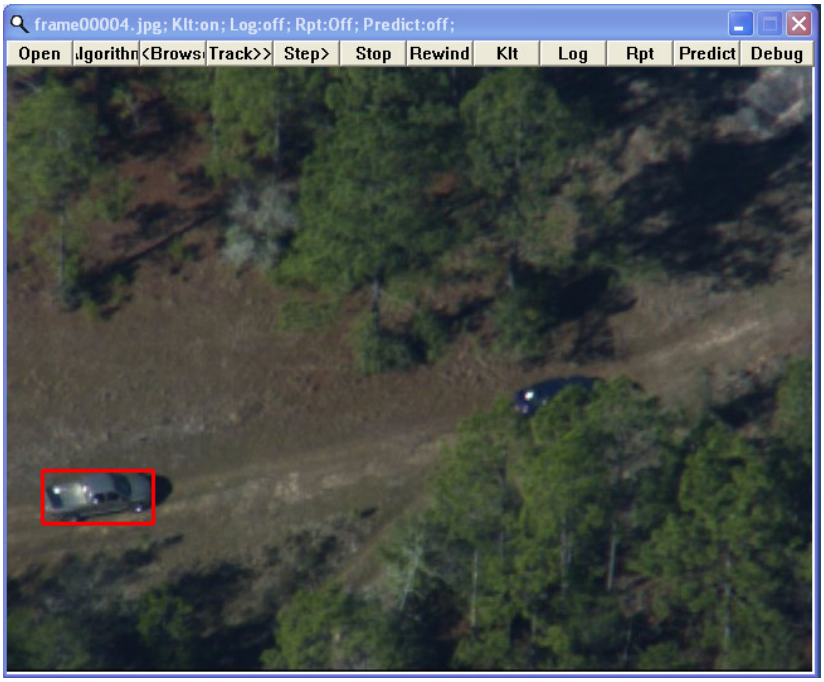

Figure 1: Main window of the Tracker Testbed

3. Quick Start: Sample Usage.

Below are two sample usage scenarios of the Tracker Testbed.

1) Track a new sequence
   - Open a new frame: Click the "**Open**" button (Figure 1) and browse directories. Select the starting image frame for the tracking sequence. The image is then displayed in the tracker main window.
   - Tracker Initialization: Click 4 points to define a polygon bounding the target object in the image.
   - Track next frame: Click **"Track>>"** to beginning tracking the object continuously through the sequence. Alternatively, click **"Step>"** to track step-by-step, one frame at a time.
   - (Optional) Save output tracking results: Click "**Log**" button before tracking to record tracking results to a log directory.

2) Play a previously recorded (logged) sequence.
   - Open a logged sequence: Click the "**Open**" button and browse directories. Open a "*.trk" file of previously logged tracking results.
   - Track next frame: Click "**Track**>>" or "**Step>**" to play back the logged results. Note that playback is much faster than tracking mode – it is just playing previously stored results.

   (Optional) Switch to track mode on the same sequence:
   - Stop playback: Click the **"Stop"** button to stop playback.
   - Rewind to beginning: Click **"Rewind"** to go back to the initial frame and object polygon.
   - Switch to track mode: Click "**Rpt**" to turn off playback mode and switch to regular tracking mode, using this starting frame and polygon.
   - Track: Click **"Track>>"** or **"Step>"** to begin tracking.

3. Command Buttons.

Figure 1 shows the tracker command buttons, located at the top of the main window. The function of each button is described below.

1) "**Open**"

Enables the user to pick an image sequence or open a previously logged sequence. Thus, there are two kinds of input files to open.

- Image sequence files in one of the following format:

Windows bitmaps	- BMP, DIB;
JPEG files	- JPG, JPE;
Portable Network Graphics	- PNG;
Portable image format	- PBM, PGM, PPM;
Sun rasters	- RAS;
TIFF files	- TIF.

- Previously recorded track file (*.trk). This log file format contains video sequence file and polygon initialization information.

2) "**Algorithm**"

As shown in Figure 2, this button prompts the user to choose a tracking algorithm. Current version of the Tracker Testbed includes the following tracking algorithms:

- Histogram Ratio Shift.
  Tracking is based on the ratio between foreground (target) and background histograms values. This algorithm emphasizes foreground pixels with colors that are well-distinguishable from the background. The number of color histogram bins can be defined in the dialog menu.

- Basic Mean-shift.
  Basic mean shift algorithm based only on object color distribution. This implementation uses a hard-coded 8*8*4 index image of normalized B-G/G-R/R+G+B values.

- Template Match by Normalized Correlation.
  Tracking based on computing the normalized correlation coefficient R between a target template and the current frame, where
  R(x,y)=sumx',y'[T'(x',y')•I'(x+x',y+y')]/sqrt[sumx',y'T'(x',y')2•sumx',y'I'(x+x',y+y')2]
  and
  I(x,y) is the image pixel value at location (x,y)
  T(x,y) is the template pixel value at location (x,y).
  T'(x',y')=T(x',y') - 1/(w•h)•sumx",y"T(x",y") (mean template brightness=>0)
  I'(x+x',y+y')=I(x+x',y+y') - 1/(w•h)•sumx",y"I(x+x",y+y") (mean patch brightness=>0)

- Variance Ratio Feature Shift
  Tracking is based on the RGB combination feature F = w1*R + w2*G + w3*B (w1, w2, w3 are weight parameters). The choice of w1, w2, w3 is to maximize variance ratio between target bounding box and its neighborhood.

- Peak Difference Feature Shift
  Tracking is based on the RGB combination feature F = w1*R + w2*G + w3*B (w1, w2, w3 are weight parameters). The choice of w1, w2, w3 is to maximize peak difference between target bounding box and its biggest noise blob in neighborhood.

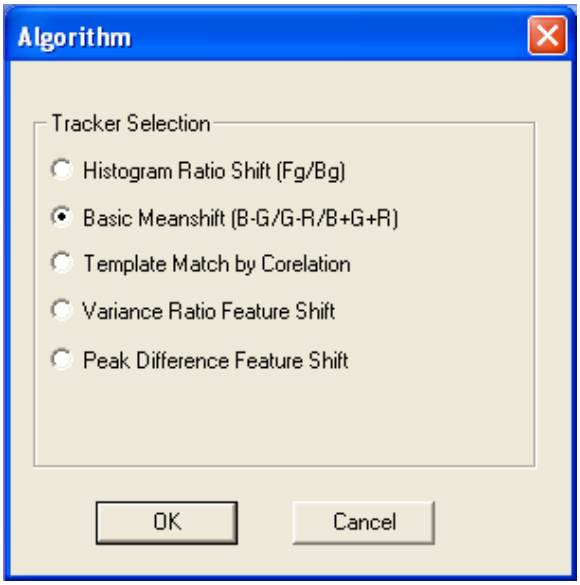

Figure 2: Algorithm Dialog for choosing a tracking algorithm.

3) "<<Browse"
This button will cancel the tracking mood and browse the frames backwards.

4) "**Track>>**"
When a tracking sequence has been initialized and 4 points around the target have been clicked, this button will invoke the tracker to run frame-by-frame over the sequence. If the tracking testbed is currently in playback mode, this button starts playback of a previously logged sequence.

5) "**Step>**"
When a tracking sequence has been initialized and 4 points around the target have been clicked, this button will run the tracker on the next frame in the sequence (single step mode). If the tracking testbed is currently in playback mode, this button advances the playback of a previously logged sequence by a single frame.

6) "**Stop**"
Stops a currently running "**Track>>**" action or playback action, and pauses at the current frame.

7) "**Rewind**"
Rewinds the sequence to the initialization frame where 4 points defining the object were clicked. If the sequence has not yet been initialized with 4 points, it will rewind to the first opened frame.

8) "**Klt**"
Toggles the Klt tracker component on/off. The Klt tracker computes sparse optic flow by detecting and matching corner features between pairs of frames in the sequence. The computed two-frame flow is used by the Tracker Testbed to do motion prediction in cases of object occlusion. If the Klt tracker mode is off, the "**Predict**" button will be disabled.

9) "**Log**"
Toggles logging of results. When turned on, this prompts the user to specify a log file directory (Figure 3). When the tracker is run with logging turned on, a series of output files specifying the bounding box and foreground mask of the tracked object in each frame are written to the specified log directory.

By default, the log directory is "(RunPath)/tkLog/Sequence_x/". The tracker creates two kinds of log files under the log directory: a single .trk file is generated for the initialization frame of the sequence, and a sequence of .rpt files are generated, one for each subsequent frame in the sequence.

- *.trk file. Specifies location of the first frame of the sequence, and the initial object polygon.
- *.rpt file. Includes tracking results (bounding box and foreground mask) for every tracked frame.

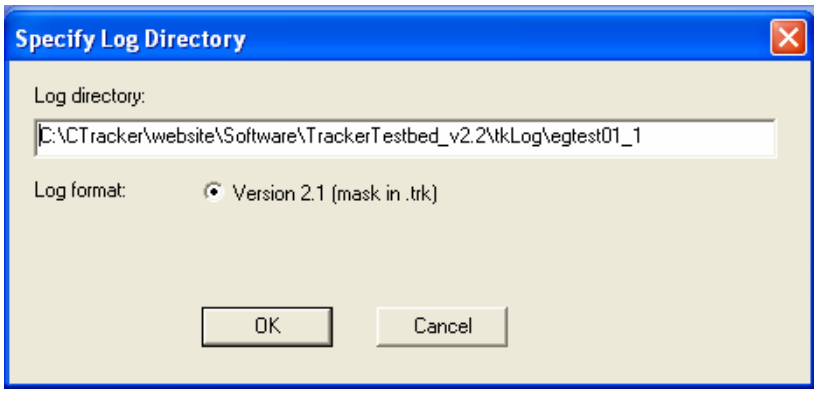

Figure 3: Dialog for specifying a directory for saving tracking results.

10) "**Rpt**"
This button toggles playback of previously logged files on/off. If Tracker Testbed has opened a previously recorded sequence (*.trk file) and "Rpt" mode is on, then the tracker commands "Track>>" and "Step>" will play back logged results for each frame. If "Rpt" mode is turned off, the Tracker Testbed will revert to its normal mode of operation and begin running the chosen tracking algorithm on the image frames.

11) "**Predict**"
Toggles motion prediction functionality on/off. When the target becomes occluded, and motion prediction mode is on, the Tracker Testbed will predict the target position (Figure 4, green line) based on the targets recent trajectory history (red line). The current motion prediction algorithm assumes the target will maintain its current speed, in a straight line (constant velocity prediction).

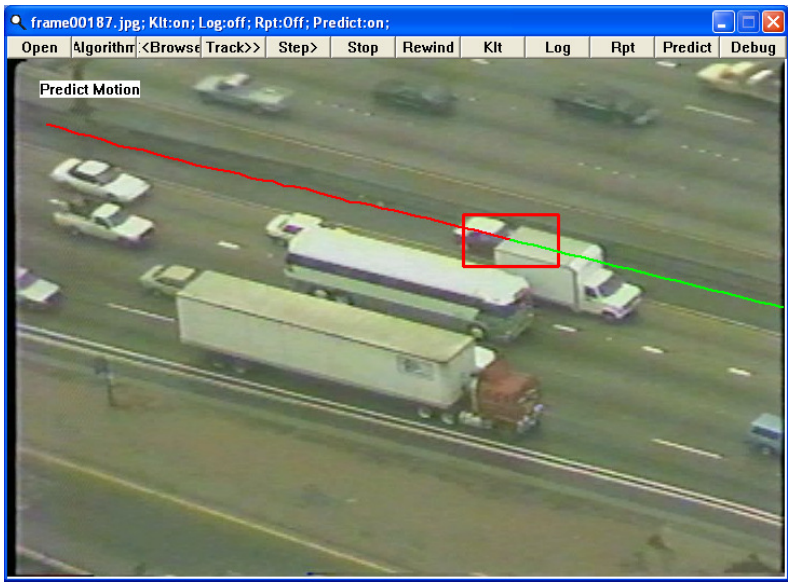

Figure 4: When motion prediction mode is on, a constant velocity path prediction is invoked with the object becomes occluded.

12) "Debug"

This button will activate the debug window as shown in Figure 5. It displays intermediate tracking results. The upper left corner image shows the current image frame. The upper right image shows clustered background feature points computed by the KLT feature tracker. The lower left image shows the weighted foreground image used for tracking, and the current bounding box of the object.

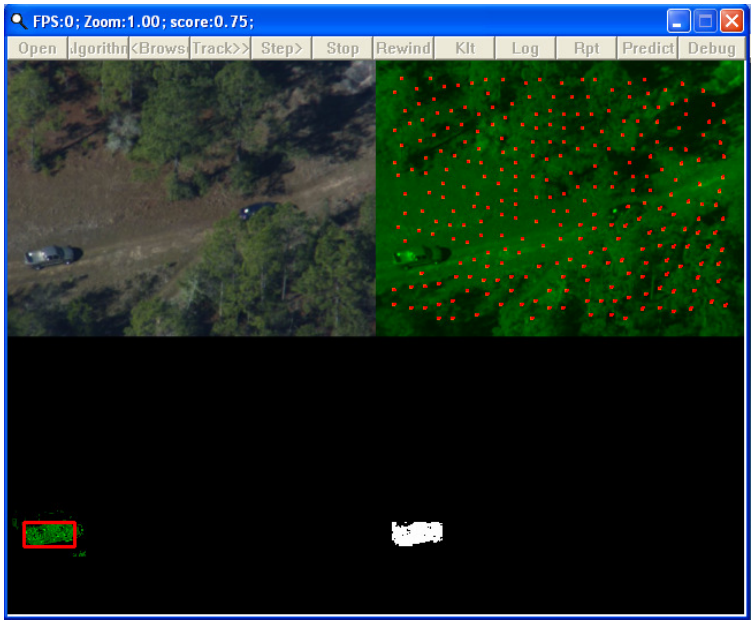

Figure 5: Debug Display Window